

We claim:

1. An implantable pulse generator housing for enclosing and containing a pulse generator for connection to at least one cardiac electrode implanted on or about the heart for delivering electrical energy to the heart, said housing comprising:

a housing body defining an electrically conductive outer surface which is electrically connected to said pulse generator, said housing for implantation proximate the heart.

2. The implantable pulse generator housing of claim 1, wherein the outer surface of said housing body comprises platinum.

3. The implantable pulse generator housing of claim 1, wherein the outer surface is microporous.

4. The implantable pulse generator housing of claim 1, wherein regions of an outer surface of the housing body are electrically isolated, select regions being dedicated for sensing cardiac signals and other regions being dedicated for discharging to the heart.

5. The implantable pulse generator housing of claim 4, wherein select regions are dedicated for serving as a ground, pacing or sensing electrode.

6. The implantable pulse generator housing of claim 5, wherein a select regions which serves as pacing or sensing electrode comprises a region of insulative material deposited on said housing body and a region of electrically conductive material deposited on the insulative material and occupying a fraction of an

area of the insulative material.

7. The implantable pulse generator housing of claim 1, and further comprising an insulative mask disposed over the outer surface of the housing body.

5 8. An implantable heart treatment system having anti-arrhythmia pacemaking, cardioversion, and defibrillation capabilities for maintaining proper function of the heart, said system comprising:

10 an implantable pulse generator means for producing an anti-arrhythmia waveform;

15 a pulse generator housing enclosing and containing said pulse generator means, said pulse generator housing formed of electrically conductive material defining an electrically conductive outer surface which is electrically connected to said pulse generator means, said housing for implantation proximate the heart;

20 an electrode for implantation in or about the heart and being electrically connected to said pulse generator for delivering electrical energy to the heart via said conductive surface of said pulse generator housing.

9. An implantable heart treatment system having anti-arrhythmia pacemaking, cardioversion, and defibrillation capabilities for maintaining proper function of the heart, said system comprising:

25 an implantable pulse generator means for producing

an anti-arrhythmia waveform;

a pulse generator housing enclosing and containing
said pulse generator means, said pulse generator housing formed of
electrically conductive material defining an electrically
conductive outer surface electrically connected to said pulse
generator means for delivering electrical energy to the heart, said
housing for implantation proximate the heart;

a first electrode implanted in or about the heart
and being electrically connected to said pulse generator;

a second electrode implanted in or about the heart
and being electrically connected to said pulse generator;

switching means for directing said anti-arrhythmia
waveform on the one hand, between said first and second electrodes
upon a first condition of said heart, and on the other hand
directing said anti-arrhythmia waveform to said first electrode and
the conductive surface of said pulse generator housing electrically
connected in common with the first electrode against said second
electrode upon a second condition of the heart.

10. The implantable heart treatment system of claim 7,
and further including a third electrode implanted on or about the
heart and connected to said switching means for sensing at least
said first and second conditions of the heart.

11. The implantable heart treatment system of claim 9,
wherein at least one of said first and second electrodes has
sensing capabilities and is connected to said switching means for

sensing at least said first and second conditions of the heart.

12. The implantable heart treatment system of claim 9,
wherein said second condition of the heart is ventricular
fibrillation.

13. The implantable heart treatment system of claim 9,
wherein said conductive surface of said pulse generator housing
comprises electrically conductive mesh.

14. An implantable heart treatment system having anti-
arrhythmia pacemaking, cardioversion, and defibrillation
capabilities for maintaining proper function of the heart, said
system comprising:

an implantable pulse generator for producing an
anti-arrhythmia waveform;

a pulse generator housing for enclosing and
containing said pulse generator, said pulse generator housing
formed of electrically conductive material defining an
electrically conductive outer surface which is electrically
connected to said pulse generator;

a transvenous lead having a first electrode and a
second electrode portion thereof, said lead being implanted in the
heart so that said first electrode is positioned in the right
ventricle and said second electrode is positioned in the vena cava
region of the heart, said lead electrically connecting said first
and second electrode to said pulse generator;

switching means for directing on the one hand, said anti-arrhythmia waveform between said first and second electrodes upon a first condition of the heart, and on the other hand directing said anti-arrhythmia waveform to said first electrode and said conductive outer surface of said pulse generator housing electrically connected in common with said first electrode against said second electrode upon a second condition of the heart.

15. The implantable heart treatment system of claim 13, and further including a third electrode implanted on or about the heart and electrically connected to said switching means for sensing at least said first and second conditions of the heart.

16. The implantable heart treatment system of claim 13 wherein at least one of said first and second electrodes has sensing capabilities and is connected to said switching means for sensing at least said first and second conditions of the heart.

17. The implantable heart treatment system of claim 13, wherein said second condition of the heart is ventricular fibrillation.

18. An implantable pulse generator housing for enclosing and containing a pulse generator for connection to at least one cardiac electrode implanted on or about the heart for delivering electrical energy to the heart, said housing comprising:

a plurality of walls, at least one of which comprises an electrically conductive electrode connected to said pulse generator and removably attached to at least one wall.

19. An implantable heart treatment system having anti-arrhythmia pacemaking, cardioversion, and defibrillation capabilities for maintaining proper function of the heart, said system comprising:

5 an implantable pulse generator means for producing an anti-arrhythmia waveform;

a pulse generator housing enclosing and containing said pulse generator means, said pulse generator housing comprising an electrically conductive electrode removably attached to the housing and capable of electrical connection to said pulse generator;

10 an electrode for implantation in or about the heart and being electrically connected to said pulse generator for delivering electrical energy to the heart against said conductive surface of said pulse generator housing.

15 20. The implantable heart treatment system of claim 19, and further comprising sensor means for determining whether the pulse generator housing is inside a body of a patient or outside the body of a patient, said sensor means for disconnecting the conductive electrode of the pulse generator housing from the pulse generator means when the housing is outside the body of a patient.

20 21. An implantable heart treatment system having anti-arrhythmia pacemaking, cardioversion, and defibrillation capabilities for maintaining proper function of the heart, said system comprising:

an implantable pulse generator means for producing an anti-arrhythmia waveform;

a pulse generator housing enclosing and containing said pulse generator means, an electrically conductive electrode removably attached to said pulse generator housing and electrically connected to said pulse generator means;

a first electrode implanted in or about the heart and being electrically connected to said pulse generator;

a second electrode implanted in or about the heart and being electrically connected to said pulse generator;

switching means for directing said anti-arrhythmia waveform on the one hand, between at least one of said first and second electrodes and said conductive surface of said pulse generator housing upon a first condition of said heart, and on the other hand directing said anti-arrhythmia waveform to said first and second electrodes electrically connected in common against said conductive surface of said pulse generator housing upon a second condition of the heart.

22. An implantable pulse generator housing for enclosing and containing a pulse generator for connection to at least one cardiac electrode implanted on or about the heart, the housing comprising:

at least four side walls, a top wall, and a bottom wall, at least one of said walls being electrically conductive and electrically connected to said pulse generator.

23. The implantable heart treatment system of claim 9,
and further comprising sensor means connected to said switching
means, said sensor means for detecting whether the pulse generator
housing is inside a body of a patient or outside a body of a
5 patient and responsive to control the switching means to disconnect
the electrically conductive outer surface from the pulse generator
means when the sensor means detects that the housing is outside the
body of the patient.

24. The implantable pulse generator housing of claim 1,
10 further comprising a second electrically conductive surface being
joined to the pulse generator housing and being electrically
connected to the electrically conductive outer surface such that
the second electrically surface and the electrically conductive
outer surface together serve as an electrode.

25. The implantable pulse generator housing of claim 24,
15 further comprising a support layer adjoining the pulse generator
housing and disposed between the pulse generator housing and the
electrically conductive outer surface for supporting and
positioning the electrically conductive outer surface, and a lead
20 for electrically connecting the electrically conductive outer
surface to the pulse generator.

26. The implantable pulse generator housing of claim 25,
wherein the second electrically conductive surface is a plurality
of coiled segment electrodes protruding from the support layer.

27. The implantable pulse generator housing of claim 24,

wherein the second electrically conductive surface is a plurality of coiled segment electrodes protruding from the pulse generator housing.

28. The implantable pulse generator housing of claim 24,
5 wherein the second electrically conductive surface is a coiled loop.

29. The implantable pulse generator housing of claim 8,
further comprising a second electrically conductive surface
adjoining the pulse generator housing and being electrically
10 connected to the electrically conductive outer surface such that
the second electrically conductive surface and the electrically
conductive outer surface together serve as an electrode.

30. The implantable pulse generator housing of claim 14,
further comprising a second electrically conductive surface
adjoining the pulse generator housing and being electrically
15 connected to the electrically conductive outer surface such that
the second electrically conductive surface and the electrically
conductive outer surface together serve as an electrode.

31. The implantable pulse generator housing of claim 22,
20 further comprising a second electrically conductive surface
adjoining the pulse generator housing and being electrically
connected to the electrically conductive outer surface such that
the second electrically conductive surface and the electrically
conductive outer surface together serve as an electrode.

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